

Properties of waves

Mark Scheme 1

Level	IGCSE(9-1)
Subject	Physics
Exam Board	Edexcel IGCSE
Module	Double Award (Paper 1P)
Topic	Waves
Sub-Topic	Properties of waves
Booklet	Mark Scheme 1

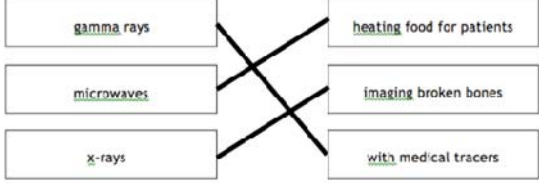
Time Allowed: 68 minutes

Score: /56

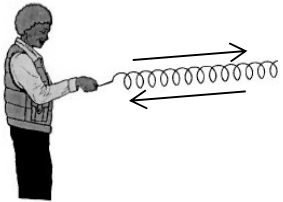
Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	60%	55%	50%	<50%

Question number	Answer	Notes	Marks
1 (a) (i)	C – speed in free space;		1
	(ii) All lines correct = 2 marks Any correct line = 1 mark <div style="display: flex; justify-content: space-around; font-size: small;"> type of electromagnetic wave use </div> 		2
	(iii) (direction of vibration) perpendicular to (direction in which the wave travels);	allow at right angles to or 90° to	1

(b)	(i)	D – 45 000 Hz;		1
	(ii)	Any two of - wave travels there and back; depth is half total distance travelled; time (to target) is half total (travel) time;	ignore phrase about reflection received as in stem	2
	(iii)	wavelength is longer in patient or wavelength shorter in air; and one of: - (because) $v = f \times \lambda$; OR (because) frequency does not change;	allow wavelength is longer in more dense medium ignore • speed related to medium • as speed increases wavelength increases	2
Total 9 marks				

Question number	Answer	Notes	Marks
2 (a) (i)	<p>arrows in opposite directions and (roughly) parallel with the length of the spring;</p> 	<p>allow</p> <ul style="list-style-type: none"> • a line with a double head • arrows to R & L <p>ignore arrow length</p> <p>arrows need not be adjacent to the spring</p> <p>judge by eye</p>	1
	(ii)	any suitable example;	1
	e.g. sound ultrasound 'p' wave	ignore waves in a slinky	

(b) (i)	<p>suitable horizontal line (labelled W); e.g. from peak to peak from trough to trough from midpoint to corresponding midpoint between any adjacent points in phase</p>	<p>judge by eye but should start and finish at suitable points</p>	<p>1</p>
(ii)	<p>2.5 (cm)</p>	<p>do not allow 5/2 allow 2 ½</p>	<p>1</p>
(iii)	<p>substitution into $f=1/T$; evaluation; unit; e.g. $f=1/15$ 0.067 Hz</p>	<p>no mark for equation as it is given on page 2 -1 for POT error ignore answers given as fractions allow 0.07, 0.0667 s^{-1} condone incorrect truncation e.g. 0.06, 0.066, 0.0666</p>	<p>3</p>

(iv)	(ring oscillates) perpendicular / at right angles}; to the direction the wave travels/eq;	allow direction of energy transfer reject 2 nd mark if reference to longitudinal wave e.g. 'ring moves parallel to the direction of the wave'	2
(v)	any suitable example; e.g. a named EM wave EM wave 's' wave	allow wave on a rope	1
total marks = 10			

Question number	Answer	Notes	Marks
3 (a) (i)	(cm)		1
	(ii) Sketched wave (at least 1 cycle) with a larger amplitude; Sketched wave (at least 1 cycle) with a longer wavelength;	Shape of wave and position of axis unimportant (i.e. ignore conditions of wind and tide)	2

(b)	<p>Any five of -</p> <p>MP1. A method to make a loud enough sound;</p> <p>MP2. Speed = $\frac{\text{distance}}{\text{time}}$;</p> <p>MP3. Need for still air;</p> <p>MP4. Repeat AND average;</p> <p>MP5. Need to check/reset stopwatch zero reading;</p> <p>MP6. Idea of clear visual signal;</p> <p>MP7. measurement of time interval (between visual signal and sound);</p> <p>MP8. Idea of reaction time(s) (could be a problem);</p>	<p>ignore measurement of distance</p> <p>bald 'clap'</p> <ul style="list-style-type: none"> • wooden blocks • noise has to heard over 100m <p>RA</p> <p>allow repeat AND sort out anomalies</p> <p>e.</p> <ul style="list-style-type: none"> • when the sound is seen to be made • smoke from starting pistol (because) light travels faster than sound 	5
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Continued

Question number	Answer	Notes	Marks
3 (c) (i) cont	wave speed = frequency \times wavelength	Allow abbreviations and rearrangements, e.g. $v=f\lambda$	1
(ii)	Conversion to Hz; Substitution into correct equation and rearrangement; Evaluation; e.g. 31 MHz = 31 000 000 Hz wavelength = 300 000 000 \div 31 000 000 9.7 m	Allow 10^6 seen at any stage allow answers which round to 9.7 (9.6774)	3
(d)	Any one of the following ideas - MP1. the two waves travel at different speeds; MP2. the two waves travel the same distance (or 1 wavelength) in different times;	ignore references to • transverse and longitudinal • em spectrum	1

Total 13 marks

Question number	Answer	Notes	Marks
4 (a) (i)	B;		1
(ii)	A;		1
(iii)	Similarity: - any wave property e.g. transfer energy, reflection, refraction, vibration; Difference: - any one of <ul style="list-style-type: none"> • longitudinal particles oscillate in {same direction/ parallel to} the direction of travel; • transverse {particles oscillates/vibration} at right angles to the direction of travel; 	Allow diffraction carry energy Allow <ul style="list-style-type: none"> • direction of energy transfer for direction of travel • only transverse waves can be polarised • transverse waves cannot travel through a liquid Ignore mention of vacuum/ medium	1

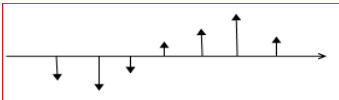
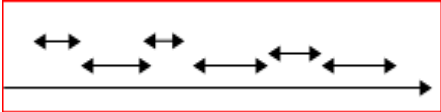
(b)

5

circle the mistake in this sentence	the correct word(s) is
They all travel at 3×10^2 m/s in a vacuum.	10^8 GIVEN
Sound waves are electromagnetic.	any of radio, micro(wave), infrared (IR), visible, ultraviolet (UV), X-ray or gamma
Infra-red waves are the most harmful to people.	gamma
Gamma waves are used for heating up food.	micro(waves)/ Infrared (IR)
Radio waves have the highest frequency.	Gamma (γ)
Gamma waves have a very long wavelength.	radio (waves)

each line for 1 mark; ; ; ; ;

(Total for Question 4 = 9 marks)

Question number		Answer	Notes	Marks
5 (a)	(i)	B- 2		1
	(ii)	C- 8		1
(b)		<p>Idea that in a transverse wave the direction of vibration is perpendicular to the direction of the wave; (May be shown with labels on the diagram)</p> <p>Idea that longitudinal wave the direction of vibration is parallel to the direction of the wave; (May be shown with labels on the diagram)</p> <p>A named freehand sketch of either wave indicating the two directions;</p> <p>e.</p>  <p>transverse</p>  <p>Longitudinal</p>	<p>Allow (for vibration) oscillation / displacement / disturbance (for direction of wave) direction of travel / energy / transfer (for perpendicular) at right angles, is \perp to (for parallel) the same as, //</p> <p>the minimum labelling is to name of the type of wave they have drawn.</p> <p>Allow sine waves with appropriate arrows</p> <p>Allow diagrams indicating compression and rarefaction e.g. in a spring</p> <p>Allow for 1 mark (but only if other mark is scored) a comparison of the directions of vibration of both waves without relating them to the direction of the wave</p> <p>e.g. transverse vibrates up and down but longitudinal vibrates back and forward</p>	3
(c)		any two of		2

		<p>MP1 can travel through vacuum OR needs no medium;</p> <p>MP2 speed (in a vacuum) OR speed = 3×10^8 (m/s);</p> <p>MP3 obeys laws of reflection / refraction;</p> <p>MP4 obeys wave equation OR speed = frequency \times wavelength;</p> <p>MP5 carries energy/ information;</p> <p>MP6 they are transverse</p>	<p>“speed in a vacuum” where seen, scores 2 marks (MP1 and MP2)</p> <p>Accept reflect, refract, diffract</p>	
(d)	i	D - X-rays		1
	ii	A – absorbed by the bone		1
	iii	<p>X-rays OR gamma rays</p> <p>idea of causing damage to cancer cells e.g. cells killed/mutated/ionised/destroys;</p>	<p>allow symbol γ do not allow UV</p> <p>Independent mark</p>	2

Question number	Answer	Notes	Marks
6 (a)	C (sound waves are longitudinal waves);		1
(b) (i)	C (the same as the amplitude of sound P);		1
(ii)	0.004 (s);	Allow answer by calculation or by reading from graph Allow equivalent value with matching unit, e.g. 4 ms	1
(iii)	500 (Hz)	Treat ii and iii as independent, but allow an ecf from ii to iii if seen Accept "double" P	1

Total 4 marks